Before the Subcommittee on Clean Air and Nuclear Safety

Environment and Public Works Committee

United States Senate

The State of Mercury Regulation, Science, and Control Technology

Testimony of

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Introduction

Mr. Chairman and distinguished members of the Subcommittee - thank you for the invitation to address the Subcommittee this morning. My name is Martha Keating and I am an Associate in Research with Duke University's Children's Environmental Health Initiative. However, my testimony today reflects only my views. My interest in testifying stems from many years of working on mercury issues, first as an EPA scientist where I was the project director for the Agency's 1997 Report to Congress on Mercury. From 1998 until October of 2006, I was a scientific consultant to numerous environmental advocacy groups on mercury regulatory issues and represented these groups as a member of the EPA's Utility MACT Working Group. My comments this morning will address mercury health effects, the EPA's Clean Air Mercury rule, and my thoughts on federal legislation.

Mercury and Fish Contamination

Outside of occupational settings, methylmercury is the most toxic form of mercury to which humans are regularly exposed and methylmercury exposure is almost exclusively from eating fish and shellfish. The primary source of methylmercury in fish and shellfish is the atmosphere.

From the atmosphere, mercury is ultimately is deposited to land and water where it can be converted by bacteria to methylmercury, a form that is especially toxic to humans and wildlife. Fish absorb methylmercury from the water as it passes over their gills and as they feed on plants and other organisms. As larger fish eat contaminated prey, methylmercury concentrations increase in the bigger fish, a process known as bioaccumulation. The concentration of methylmercury in these fish can be up to 10 million times higher than the surrounding water and reach levels that make the fish unsafe for humans and wildlife to consume. Elevated levels of methylmercury in fish have prompted concerns about the public health hazards from methylmercury exposure. Despite the known nutritional and health benefits from eating fish, in 2004, public health agencies in 44 states issued fish consumption advisories warning citizens to limit how often they eat certain types of fish because the fish are contaminated with high levels of mercury.[1] According to EPA's latest estimates, coal-fired power plants are responsible for more than 45 percent of the country's industrial mercury emissions.[2]

Mercury Exposure and Health Effects

Methylmercury is a neurotoxin – a substance that damages, destroys, or impairs the functioning of nerve tissue. It poses the greatest hazard to the developing fetus. It passes easily through the placenta and impairs the development of the brain and nervous system. Prenatal methylmercury exposure from maternal consumption of fish can cause later

[1] http://www.epa.gov/waterscience/fish/advisories/fs2004.html#synopsis
[2] U.S. EPA, 2002 National Emissions Inventory. http://www.epa.gov/ttn/chief/eiinformation.html

neurodevelopmental effects in children.[3] Infants appear normal during the first few months of life, but later display subtle effects. These effects include poor performance on neurobehavioral tests, particularly on tests of attention, fine motor function, language, visual-spatial abilities (e.g., drawing) and memory. These children will likely have to struggle to keep up in school and might require remedial classes or special education.[4]

Methylmercury exposure prior to pregnancy is as critical as exposure during pregnancy because methylmercury stays in the body for months and is slowly excreted. Many of the critical stages of brain and nervous system development occur during the first two months after conception and since many women do not know they are pregnant during that time, the fetus may be exposed to high levels of methylmercury. Because of the risk methylmercury poses to the developing fetus, women of childbearing age (i.e., 15 to 44 years of age) who might become pregnant and pregnant women are the most important members of the population in terms of mercury exposure.[5]

Infants and children are also at risk. Infants may ingest methylmercury from breast milk and children are exposed through their diet. Children and infants may be more sensitive to the effects of methylmercury because their nervous systems continue to develop until about age 16. Children also have higher methylmercury exposures than adults because a child eats more food relative to his or her body weight than an adult does. As a result, they have a higher risk for adverse health effects.[6]

Based on blood monitoring data collected by the National Health and Nutrition Examination Survey (administered by the Centers for Disease Control and Prevention), an estimated 200,000 to 400,000 children born in the United States each year have been exposed to mercury levels in utero high enough to put them at risk of neurological effects.[7]

What do these staggering numbers mean for childhood development, for our education system and for our society? Developmental and learning disabilities, including loss of IQ points, have negative impacts not only on individuals, but also have long-term

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[3] Committee on the Toxicological Effects of Methylmercury. Board on Environmental Studies and Toxicology. Commission on Life Sciences. National Research Council. Toxicological Effects of Methylmercury, 2000. National Academy Press. Online. Available: http://www.nap.edu/books/0309071402/html/

[4] Committee on the Toxicological Effects of Methylmercury. Board on Environmental Studies and Toxicology. Commission on Life Sciences. National Research Council. Toxicological Effects of Methylmercury, 2000. National Academy Press. Online. Available: http://www.nap.edu/books/0309071402/html/

[5] U.S. EPA, 1997b. Mercury Study Report to Congress, Volume VII: Characterization of Human and Wildlife Risks from Mercury Exposure in the United States. EPA-452/R-97-009

[6] U.S. EPA, 1997b. Mercury Study Report to Congress, Volume VII: Characterization of Human and Wildlife Risks from Mercury Exposure in the United States. EPA-452/R-97-009

[7] Hightower, J.M., A. O'Hare, G.T. Hernandez, 2006. Blood mercury reporting in NHANES: Identifying Asian, Pacific Islander, Native American, and multiracial groups. Environmental Health Perspectives, Volume 114, Number 2, February.

consequences for the population and society as a whole.[8] Chemical contamination of the brain affects not only the educational attainment, economic performance and income of the individual, but it also has an impact on the performance of the economy as a whole by affecting society's potential production, rate of technical progress, and overall productivity.[9]

Lowered IQ has a documented relationship with economic outcomes such as lifetime earnings.[10] Even small decrements in IQ have been linked with lower wages and earnings. Two recent studies have attempted to calculate the societal cost of methylmercury exposure in the U.S and the related economic benefits of reducing such exposure. The Center for Children's Health and the Environment at the Mt. Sinai School of Medicine concluded that exposure to methylmercury causes lifelong loss of intelligence in hundreds of thousands of American babies born each year. This loss of intelligence exacts a significant economic cost to American society - a cost that they estimate to be in the hundreds of million dollars each year.[11]

In a different study, the Northeast States for Coordinated Air Use Management (NESCAUM) in collaboration with the Harvard School of Public Health quantified how decreasing mercury emissions from coal-fired power plants would result in less methylmercury exposure and consequently, IQ point gains for the population of children born each year.[12] According to this study, a 70% decrease in coal-fired power plant mercury emissions by 2018 would result in benefits to society of between $119 million to $288 million every year. Consequently, a reduction in emissions of more than 70% would result in even greater benefits. Extrapolating these results, a 90% reduction in emissions would result in benefits to society worth more than $370 million per year.

Effects on IQ however, may be just the tip of the iceberg[13]. A lower IQ may be the easiest to quantify and put a dollar value on, but this effect may not be the most serious in terms of life and career outcomes. Toxicants like methylmercury that affect the nervous system, alter a person's ability to plan, organize, and initiate ideas and which may induce

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[8] Muir, T. and M. Zegarac, 2001. Societal costs of exposure to toxic substances: economic and health costs of four case studies that are candidates for environmental causation. Envr. Health Perspect. Volume 109, Sup. 6, pp. 885-903. December.

[9]Muir, T. and M. Zegarac, 2001. Societal costs of exposure to toxic substances: economic and health costs of four case studies that are candidates for environmental causation. Envr. Health Perspect. Volume 109, Sup. 6, pp. 885-903. December.

[10]Muir, T. and M. Zegarac, 2001. Societal costs of exposure to toxic substances: economic and health costs of four case studies that are candidates for environmental causation. Envr. Health Perspect. Volume 109, Sup. 6, pp. 885-903. December.

[11] Trasande, L., P. Landrigan and C. Schechter, 2005. Public health and economic consequences of methylmercury toxicity to the developing brain. *Environ Health Perspect*: doi:10.1289/ehp.7743. [Online 28 February 2005] http://ehp.niehs.nih.gov/docs/2005/7743/abstract.html

[12] Northeast States for Coordinated Air Use Management. Economic valuation of human health benefits of controlling mercury emissions from U.S. coal-fired power plants. February, 2005.

[13] Axelrad, D.A., D.C. Bellinger, L.M. Ryan, and T.J. Woodruff, 2007. Dose-response relationship of prenatal mercury exposure and IQ: An integrative analysis of epidemiologic data. Environ Health Perspect.; 115(4): 609–615.

problems with attention, distractibility, impulsive behavior and inability to handle stress and disappointments. These effects could be far more serious with respect to success in school and life.[14]

There is also evidence in humans and animals that exposure to methylmercury can have adverse effects on the developing and adult cardiovascular system, blood pressure regulation, heart-rate variability, and heart disease.[15] The benefit of reducing these adverse health outcomes has been estimated to be in the billions of dollars.[16]

EPA's Clean Air Mercury Rule

It was public health impacts that concerned Congress when in the 1990 amendments to the Clean Air Act EPA was directed to investigate mercury and other hazardous air pollutant emissions from coal-fired utility plants, and to determine whether regulation of these pollutants was appropriate and necessary. As you know, EPA has since "revised" it positive regulatory finding, removed coal-fired utility boilers from the list of source categories that emit hazardous air pollutants, and finalized a cap and trade rule. The paper trail in the docket for this rule revealed:

- EPA's verbatim use of language from industry memoranda in numerous sections of the Federal Register notice to justify regulatory decisions,
- the emission limits in the rule were pre-selected by EPA management to mirror the caps in President Bush's Clear Skies Initiative, and
- EPA's models estimated that only a 50 percent reduction in emissions would occur by 2020, not a 70% reduction by 2018 as claimed by the Agency.

Two reports by EPA's Inspector General concluded that EPA's regulatory process was "compromised", there was a lack of transparency in the regulatory process, and that EPA did not fully analyze the rule's impacts on children's health.[17] The IG also found that the EPA did not fully address the potential for hot spots and has no plan in place to monitor for such hot spots.[18] A report by the Government Accountability Office highlighted serious deficiencies in EPA's cost-benefit analysis of mercury control options.[19] The Congressional Research Service questioned why the proposed rule was not more

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[14]Muir, T. and M. Zegarac, 2001. Societal costs of exposure to toxic substances: economic and health costs of four case studies that are candidates for environmental causation. Envr. Health Perspect. Volume 109, Sup. 6, pp. 885-903. December.

[15] U.S. EPA, 1997b. Mercury Study Report to Congress, Volume VII: Characterization of Human and Wildlife Risks from Mercury Exposure in the United States. EPA-452/R-97-009

[16]Northeast States for Coordinated Air Use Management. Economic valuation of human health benefits of controlling mercury emissions from U.S. coal-fired power plants. February, 2005.

[17] U.S. EPA, 2005. Office of Inspector General. Additional analyses of mercury emissions needed before EPA finalizes rules for coal-fired electric utilities. 2005-P-00003, February 3, 2005.

[18] U.S. EPA, 2006. Office of Inspector General. Monitoring needed to assess impact of EPA's Clean Air Mercury Rule on potential hotspots. 2006-P-00025, May 15, 2006.

[19] U.S. Government Accountability Office, 2005. Observations on EPA's cost-benefit analysis of its mercury control options. GAO-05-252. www.gao.gov/cgi-bin/getrpt?GAO-05-252.

stringent given that the benefits of the rule far outweighed the costs[20], and in a follow-up report wondered exactly what EPA's estimated control costs even represent given that so few mercury control installations were predicted.[21]

Two years have already passed since EPA finalized the Clean Air Mercury Rule. However, CAMR is so legally suspect in its cap and trade approach that dozens of environmental groups and states have filed lawsuits, and so lenient in its emission caps and timeframes that 22 states have developed programs that are more stringent. This patchwork approach is the wrong one for a national problem, especially for a pollutant where emissions from one state may affect citizens in other states. The fact that the Subcommittee is holding this hearing illustrates the degree to which EPA has failed in its mission.

A Legislative Solution

A legislative approach that integrates requirements for all of the major pollutants emitted by power plants would address many of the shortcomings of CAMR rule by including the following requirements for mercury:

- A stringent national cap accompanied by a percent reduction requirement or efficiency-based emission rate at each boiler.
- The same emission rates for all coal types, not more lenient standards for our nation's most polluting coals.
- Timeframes that are realistic, but tight enough to encourage technology development and innovation, not a wait-and-see attitude.
- Regulatory flexibility in the form of averaging times and safe harbor provisions.
- A requirement for EPA to assess the effectiveness of the standard both through a national monitoring program and residual risk analysis.

Hotspots and Cap-and-Trade

Why not a cap and trade program for mercury? First, let's set aside questions of whether a cap and trade program for mercury is legal under the Clean Air Act, or whether such a program is prudent public health policy for a persistent, bioaccumulative neurotoxicant. A concern with this approach is that some facilities will not reduce their mercury emissions, preferring instead to purchase mercury pollution credits. Thus, emissions at a given facility might stay the same or even increase. The public health and environmental question then is whether mercury hot spots (areas of high mercury deposition, or water quality parameters that favor mercury methylation and high levels of mercury in biota) exists today, and whether a regulatory scheme that does not require all sources to reduce emissions will improve these areas or worsen them.

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[20] Congressional Research Service, 2005. Mercury emissions from electric generating units: A review of EPA analysis and MACT determination. CRS Report RL 32744, January 21, 2005.

[21] Congressional Research Service, 2006. Mercury emissions from electric power plants: An analysis of EPA's cap-and-trade regulations. CRS Report RL 32868, January 13, 2006.

The Agency's argument that hot spots are unlikely to occur relies on prior experience under the Clean Air Act's sulfur dioxide trading in the Acid Rain program. However, the Clean Air Mercury Rule is not comparable to the Acid Rain program. Sulfur dioxide emissions from power plants are regulated by at least 5 other regulatory programs under the Clean Air Act, not the trading program alone (for example, National Ambient Air Quality Standards, New Source Review, New Source Performance Standards, Prevention of Significant Deterioration, and haze rules). No such minimum standards exist as a back-stop in the mercury cap-and-trade rule.

The EPA also relies on the results of a computer model that predicts that much of the mercury emitted from a given facility disperses into the atmosphere and does not deposit in the local vicinity, thus there is no risk of hot spots either occurring or becoming worse. However, EPA's computer modeling results are not supported by monitoring results. A comprehensive multi-year EPA-funded study in Steubenville, Ohio measured the amount of local deposition that can be attributed to local coal-burning sources. Contrary to EPA's results that most mercury deposition in the US is from global sources, not local sources, the Steubenville study found that in an area dominated by coal-fired power plants, 70% of the mercury deposition could be attributed (by taking measurements, not by computer modeling) to local sources.[22] These findings are particularly significant because not only do these findings contradict the computer modeling EPA used in developing the Clean Air Mercury Rule,[23] they highlight the potential for reducing local and regional mercury deposition by controlling local sources.

Further, in a just completed 10-year study of hotspots in the northeastern U.S. and southern Canada, researchers found numerous instances of wildlife with blood mercury levels high enough to be poisonous and one hotspot in New Hampshire, downwind of several coal-fired power plants with mercury deposition five times higher than EPA's modeled estimates for the same area.[24] Given the extent of mercury fish contamination across the country, we can reasonably assume that other such deposition hot spots exist. Therefore, the nation as a whole will not benefit from a cap and trade rule that reduces mercury emissions in some locations, but not all.

Addressing the question of how fish concentrations respond to reductions in mercury emissions and deposition are multiyear studies in Wisconsin, Florida, and Massachusetts. These field studies correlated control of local emission sources with decreases in mercury deposition and subsequent reductions in fish mercury concentrations. Notably, in each case, the reductions in fish tissue concentrations were far greater and occurred much faster than scientists thought the reductions would occur. In fact, research now shows that newly deposited mercury is more reactive in the environment than previously deposited mercury. Thus, aquatic systems can respond rapidly to changes (e.g.,

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[22] Keeler, G.J., M.S. Landis, G.A. Norris, E.M. Christianson and J.T. Dvonch, 2006. Sources of mercury wet deposition in Eastern Ohio, USA. Environ, Sci, Tech, 40, 5874-5881.

[23] U.S. EPA, 2005. Technical Support Document for the Final Clean Air Mercury Rule: Air Quality Modeling. Downloaded from: http://www.epa.gov/ttn/atw/utility/aqm_oar-2002-0056-6130.pdf

[24] Evers, D. and Charles Driscoll. "The Danger Downwind", New York Times, Op-Ed, April 26, 2007.

decreases) in mercury deposition.[25, 26] In Wisconsin, researchers found that changes in atmospheric mercury deposition had rapid effects on fish mercury concentrations.[27] A 10% decline in mercury deposition correlated with a 5% decline in fish mercury concentration over a period of one year. Researchers measured a 30% decline in fish mercury concentration over a six-year period.

In South Florida, local mercury emission rates from waste incinerators decreased by more than 90% since peaking in the late 1980s and early 1990s as a result of pollution prevention and the issuance of stringent State emission limits. As a result, mercury in the fish and wildlife of the Everglades has declined by more than 75% since the mid-1990's – a recovery that the researchers called "remarkable" (for both the extent of the recovery and how quickly it occurred).[28] From the time emissions started to decrease, it took from 6 to 36 months before decreases in largemouth bass mercury concentrations were detected.

While industry critics claim that the results in South Florida are not applicable to other parts of the U.S. because of the unique attributes of the Everglades system, these results have been duplicated in Massachusetts as well. In February 2006, the Commonwealth of Massachusetts released the findings from the first 5 years of a multi-year monitoring effort designed to gauge the effectiveness of mercury pollution controls in reducing fish mercury concentrations in local lakes.[29] The study found that declines in fish mercury concentrations correlated with the decline in mercury emissions after the installation of mercury controls on incinerators in Northeastern Massachusetts. The most significant decline in fish mercury concentrations (a decrease of about 47% from 1999 to 2004) occurred where numerous local point sources either ceased operation or achieved substantial reductions in mercury emissions.

These studies indicate that fish mercury levels may respond rapidly to changes in mercury deposition, thus bolstering the case for either States to impose more stringent mercury limits on a tighter timeframe than the more lenient federal Clean Air Mercury Rule, or for Congress to unify this patchwork of state laws with comprehensive power plant air pollution legislation.

Thank you again for the opportunity to testify.

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[25]Hintellmann, H., et al. 2002. Reactivity and Mobility of New and Old Mercury Deposition in a Boreal Forest Ecosystem during the First Year of the METAALICUS Study. Environmental Science & Technology 36(23):5034-40.

[26] Bariarz, C.L., et al. 2003. A Hypolimnetic Mass Balance of Mercury From a Dimictic Lake: Results from the METAALICUS Project. Journal De Physique IV 107:83-6.

[27]Hrabik, T.R. and C.J. Watras, 2002. Recent declines in mercury concentration in a freshwater fishery: isolating the effects of de-acidification and decreased mercury deposition in Little Rock Lake. The Science of the Total Environment, 2002.

[28] Florida Department of Environmental Protection, 2003. Integrating atmospheric mercury deposition and aquatic cycling in the Florida Everglades: An approach for conducting a Total Maximum Daily Load analysis for an atmospherically derived pollutant. Integrated Summary: Final Report. October.

[29]Massachusetts Department of Environmental Protection, 2006. Massachusetts Fish Mercury Monitoring Studies: Long-Term Monitoring Results, 1999-2004.
http://www.mass.gov/dep/toxics/stypes/hgres.htm#monitoring